

EVALUATION OF VARROACIDAL EFFICACY OF BIOWAR PREPARATION

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Received 30 August 2007; accepted 31 October 2007

S u m m a r y

In the years 2005-2006, in an apiary of the Apicultural Department of the Agricultural University in Szczecin, a study was conducted into the efficacy of *V. destructor* invasion control with a Biowar preparation (s.a. amitraz). The first year of the study covered 10, and the second year covered 14 colonies living in Wielkopolski-type hives (frame 360x260 mm in size). Since 2005, the varroacidal effectiveness of Biowar was determined based on the extent of acarina mitefall in each colony, during Biowar exposure and control application of Apifos (s.a. bromfeninfos). In 2006, two methods of evaluation were applied, namely: the above-mentioned one and another based on the intensity of bee infestation with mites before and after the removal of Biowar strips. The effectiveness of Biowar was assessed based on the extent of mitefall and accounted for 87.81% in 2005 and for 81.07% in 2006, whereas that determined in the same year based on bee infestation with mites before and after the treatment was by 5.35 % lower and was more diversified in colonies.

Keywords: amitraz, effectiveness, *Varroa destructor*, honey bee

INTRODUCTION

Varroosis is still a severe, parasitic disease of honey bee, induced by *Varroa destructor* mites (Anderson, Trueman 2000). One of the first, effective agents against varroosis was a TCL preparation (Romaniuk, Lipiński 1981). It belongs to contact-type acaricides, and its active substance is amitraz. In spite of the fact that amitraz is a lipophilic compound, due to its considerable instability it does not leave stable residues in wax nor in honey (Wallner 1999, Korta et al. 2001). In honey collected from colonies treated with amitraz-containing preparations, it occurs in trace amounts (Lodesani et al. 1992, Hemmerling et al. 1999, Floris et al. 2001, Maver and Poklukar 2003, Sabatini et al. 2003), substantially lower than the maximum residue level (MRL - 200 µg/kg honey), stipulated in the 2377/90/EEC Regulation for

EU Member States. Amitraz constitutes an active substance of effective varroacidal preparations, the so-called I generation preparations, used in the form of smoke or evaporation (Marchetti and Barbattini 1984; Romaniuk 1985, 2000). However, they have been claimed to be troublesome in practice (Romaniuk 2000). Far more convenient in use are the so-called III generation preparations, in the form of plastic strips. In Western Europe, a recognized preparation with amitraz incorporated into the strip's mass is Apivar, which was introduced onto the market by a French company Laboratories Biove S.A. (Floris et al. 2001). In turn, in Poland in the year 2004, Biowet Puławy commenced the production of two preparations: Apitraz (strips covered with a microlayer with 200g of amitraz) and Biowar (strips with 400 g of amitraz incorporated into their mass). According to

Huras et al. (2004) and Chuda-Mickiewicz et al. (2007), once applied following producer's recommendations, Apitraz (in both experimental and commercial series) achieved high (87-99%) effectiveness of a therapeutic treatment. In contrast, as evaluated by Bieńkowska et al. (2005), it displayed lower efficacy that ranged, depending on the assessment method, from 71% (evaluation of bee infestation before and after treatment) to 84% (determination of mitefall).

The reported study was aimed at evaluating the effectiveness of controlling invasions of *Varroa destructor* with a Biowar preparation in honey bee colonies.

MATERIAL AND METHODS

Experiments were carried out in an apiary of the Apiculture Department, Agricultural University in Szczecin, in the years 2005-2006. In the first year analyses were conducted from the end of August till the third decade of October, whereas in the second year from the third decade of August till the end of October. In the experimental years of 2005 and 2006, they covered 10 and 14 colonies, respectively, living in Wielkopolski-type hives (frame 360x260 mm in size) with a similar strength – bees swarmed on 8 to 10 combs, including 3-5 brood combs. In order to determine the initial infestation of colonies with *Varroa destructor* mites, in both experimental years (2005 and 2006) prior to treatment, samples of bees (ca. 300 worker bees) were collected from brood combs of all honey colonies and in 2006 also ca. 4 cm² sections of combs with sealed brood with over 300 developmental forms of honey bee workers (Pohorecka 2003). Next, two strips of Biowar were introduced into each colony, i.e. hung in outermost alleys with brood for the period of 5 weeks (30th August – 4th October) in 2005 and for 7 weeks (21st August – 9th October) in

2006. Afterwards, they were exchanged with two strips of Apifos (s.a. bromfeninfos), that were removed from the colonies after 3 weeks. Mitefall of *V. destructor* was controlled every 7th day, by counting dead mites on screened bottom boards. In 2006, control application of Apifos was preceded by the collection of samples of bee and capped brood.

In 2005, the varroacidal effectiveness of Biowar was determined based on the extent of the fall of mites in each colony, during exposure of Biowar and control application of Apifos (Konopacka et al. 2000). In 2006, two methods of assessment were applied, i.e. the above-mentioned one and another based on the intensity of bee infestation with mites before and after the removal of Biowar strips (Londzin, Śledziński 1996).

RESULTS

Initial intensity of *Varroa destructor* invasion in experimental colonies was highly diversified (Table 1). For bees, it ranged from 0.0 to 7.57 % in 2005 and from 0.0 to 7.17% in 2006. In particular experimental years, the average intensity did not differ significantly, yet in 2006 it was lower by 0.68%. In that year, when analyzed on brood it ranged from 1.97% to 37.53 %, at invasion extensiveness ranging from 0.99 to 11.13%. On average, 16.07 mites were feeding on 100 developmental forms, and out of 100 cells of uncapped brood 4.9% were infested with the parasite (Table 1).

Table 2 presents the results obtained for the extent of fall of mites collected from bottom boards of hives in the period of treatment with Biowar and a control application of Apifos. In 2005, during the 5-week exposure of Biowar strips, in each colony the average number of fallen mites accounted for 1039.9, whereas in 2006 after the 7-week exposure of Biowar it accounted for 454.71. The control application of Apifos resulted in 144.3 and 106.14

Table 1

Infestation of colonies with *Varroa destructor* before treatment.

Experimental material	Invasion extent	Year	Number of colonies	Infestation	
				range	mean
Bees	intensity (%)	2005	10	0.0-7.57	2.41 a*
		2006	14	0.0-7.17	1.73 a
		\bar{x}			1.95
Brood	intensity (%)	2006	14	1.97-37.53	16.07
	extensiveness (%)			0.99-11.13	4.90

* values denoted with the same letters are not statistically different at $p \leq 0.05$

Table 2

Varroacidal efficacy of Biowar assessed based on falling rate of *Varroa destructor*.

Year	Falling rate of <i>Varroa destructor</i>	Biowar		Control (Apifos)	
		range	mean	range	mean
2005	mite number/colony %	151 - 4232	1039.90	34 - 407	144.30
		51.17 - 96.34	87.81 a*	3.66 - 41.83	12.19
2006	mite number/colony %	213 - 1675	454.71	22 - 201	106.14
		62.10 - 96.71	81.07 a	3.29 - 37.90	18.83
\bar{x}	mite number/colony %		698.54		122.04
			85.13		14.87

Table 3

Infestation of colonies with *Varroa destructor* after treatment with Biowar (2006).

Experimental material	Number of colonies	Invasion extent	Infestation	
			range	mean
Bees	14	intensity (%)	0.0-3.94	0.42
Brood	13	intensity (%)	0.71-25.92	7.61
		extensiveness (%)	0.35-5.32	3.16

of mites collected in 2005 and 2006, respectively, from one colony. Taking the total mitefall as 100%, the mean effectiveness of Biowar reached 87.81% in 2005 and 81.07% in 2006, whereas in both experimental years it accounted for 85.13%. The differences reported between experimental years were not confirmed statistically.

In assessing the number of mites collected onto bottom boards in the subsequent weeks of applying Biowar, followed by Apifos, differences were observed in the falling of the mites. In 2005, during the 5-week exposure of Biowar, the highest number of dead mites (ca. 66%) was recorded in the first, second, and third week (Fig. 1). In contrast, in the second experi-

mental year (2006), with an exposure period of Biowar elongated to seven weeks, the mitefall was observed to be even. In the subsequent weeks of strips' exposure in the colonies, it constituted 8-16% of the total fall of *V. destructor* (Fig. 1). It was likely to result from the presence of brood in the colonies. In 2005, in most colonies the brood was no longer present at the moment of Biowar strips' removal, whereas in 2006 – except for one colony – the brood was still present on one or two combs. Relatively high air temperature facilitated the brooding of queens in the period of Biowar exposure (Fig. 1). It seems that the presence of brood in colonies could also significantly affect the therapeutic effect of Biowar, for in 2006 the highest efficacy of that miticide – 96.71%, was obtained in a

colony in which no brood was observed at the moment of strips' removal. In the other colonies, *V. destructor* was detected in the collected samples. The intensity of brood infestation accounted for 7.61% on average, whereas extensiveness – for 3.16% (Table 3). In turn, examinations of adult bees pointed to a considerably greater diminishment of invasion, by 0.42% on average (Table 3). Taking into account the coefficient of intensity of *V. destructor* invasion on adult bees before and after application of Biowar, its effectiveness appeared to be lower by 5.35% on average than that determined based on the control application of the varroacidal preparation to colonies (Table 4). Differences observed in the average effectiveness of the preparation, determined by means of the two methods, did

Table 4

Therapeutic efficacy of Biowar assessed with two methods.

Colony No.	Falling rate of <i>V. destructor</i>			Bee infestation with <i>V. destructor</i> before and after treatment		
	number of dead mites		efficacy (%)	intensity of bee infestation (%)		efficacy (%)
	Biowar	control (Apifos)		before treatment	after treatment	
1	253	81	75.75	1.80	0.47	73.89
2	357	73	83.02	0.00	0.79	0.00
3	406	161	71.60	2.13	0.00	100
4	308	188	62.10	1.70	0.00	100
5	213	52	80.38	0.33	0.00	100
6	305	43	87.64	1.02	0.00	100
7	1675	187	89.96	7.17	3.94	45.05
8	414	160	72.12	3.25	0.00	100
9	261	70	78.85	1.89	0.75	60.31
10	322	60	84.29	1.24	0.00	100
11	647	22	96.71	1.04	0.66	36.54
12	352	42	89.34	1.47	0.00	100
13	498	146	77.33	1.74	0.00	100
14	355	201	62.85	2.85	0.00	100
\bar{x}	454.71	106.14	81.07 a	1.73	0.42	75.72 a

* values denoted with the same letters are not statistically different at $p \leq 0.05$

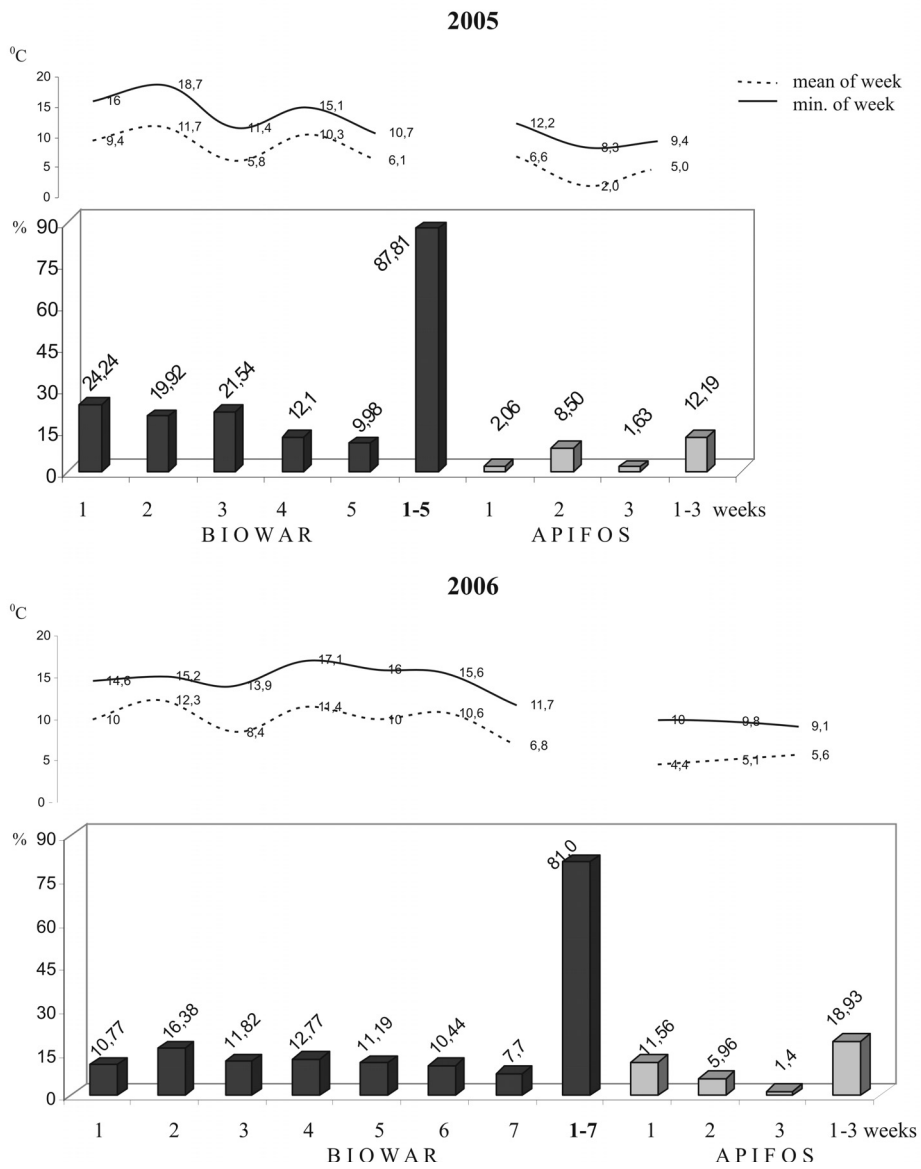


Figure 1. Effectiveness of *Varroa destructor* control

not differ significantly. Nevertheless, in the evaluation of its therapeutic efficacy considerable differences occurred in particular colonies (Table 4). For instance, in colony No. 2, the effectiveness of Biowar calculated based on the coefficient of bee infestation equaled zero, whereas that computed based on mitefall analysis reached 83.02%. In turn, in colony No. 14, 100% effectiveness of the drug was obtained when analyzed based on bee infestation, and 63.85% effectiveness when assessed based on mitefall extent from the control assay (Table 4).

DISCUSSION

The observed lower efficacy of Biowar (by ca. 7 %) in the second year of the study, despite 2-week longer exposure time, seems to be connected with the presence of brood in colonies. It approximated that obtained by Floris et al. (2001) for Apivar (83.8%), at 6-week exposure of strips in colonies with brooding queens. According to Bienkowska et al. (2005) and Pohorecka et al. (2006), depending on the method of assay, two strips of Biowar fixed in a hive for 6 weeks kill from 75 to 90% of mites, whereas the effectiveness of the preparation is considerably diversified in individual colonies. Pohorecka (2006) suggests that this may be linked with the emergence of a population of *V. destructor* resistant to amitraz in Poland. The unequal efficacy of the Biowar preparation observed in the current study could have also indicated the resistance of *V. destructor* to amitraz. However, the evaluation of its varroacidal activity in a colony was found to depend on the assessment method applied. The results obtained indicate that the method of *V. destructor* control based on bee infestation with mite is loaded with a greater error than the assessment of parasite fall.

SUMMARY

Biowar is characterized by relatively high varroacidal efficacy. Its therapeutic effect seems to be determined by the presence of brood in a colony. The impact of brood presence in a colony on the varroacidal activity of Biowar and mites resistance to amitraz require further investigations.

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OCENA SKUTECZNOŚCI WARROABÓJCZEJ PREPARATU BIOWAR

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S t r e s z c z e n i e

W latach 2005-2006 w pasiece Zakładu Pszczelnictwa Akademii Rolniczej w Szczecinie oceniano skuteczność zwalczania inwazji *V. destructor* preparatem Biowar (s.a. amitraz) w rodzinach pszczoły miodnej. W pierwszym roku badaniami objęto 10 a w drugim roku 14 rodzin bytujących w ulach wielkopolskich (ramka 360x260 mm). Skuteczność warroabójczą Biowaru w 2005 r. określono na podstawie wielkości osypu roztocza, w każdej rodzinie, w trakcie ekspozycji Biowaru oraz kontrolnego zaaplikowania Apifosu (s.a. bromfenwinfos). W 2006 r. zastosowano dwie metody oceny, powyższą oraz na podstawie intensywności porażenia pszczół roztoczem przed i po usunięciu pasków Biowaru. Skuteczność Biowaru oceniona na podstawie wielkości osypu roztocza wynosiła 87,81% w 2005r. i 81,07% w 2006r., a określona na podstawie porażenia pszczół roztoczem przed i po zakończeniu leczenia, była o 5,35% niższa i bardziej zróżnicowana w rodzinach.

Słowa kluczowe: amitraz, *Varroa destructor*, pszczoła miodna, skuteczność.